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Effects of excessive use of mobile phone technology in India on human health during COVID-19 lockdown

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ABSTRACT

Objective: The global health crisis in the form of COVID-19 has forced people to shift their routine activities into a remote environment with the help of technology. The outbreak of the COVID-19 has caused several organizations to be shut down and forced them to initiate work from home employing technology. Now more than ever, it's important for people and institutions to understand the impact of excessive use of mobile phone technology and electronic gadgets on human health, cognition, and behavior. It is important to understand their perspective and how individuals are coping with this challenge in the wake of the COVID-19 pandemic. The investigation is an effort to answer the research question: whether dependency on technology during lockdown has more effects on human health in comparison to normal times.

Methods: The study included participants from India (n = 122). A questionnaire was framed and the mode of conducting the survey chosen was online to maintain social distancing during the time of the Pandemic. The gathered data was statistically analysed employing RStudio and multiple regression techniques.

Results: The statistical analysis confirms that lockdown scenarios have led to an increase in the usage of mobile phone technology which has been confirmed by around 90% of participants. Moreover, 95% of the participants perceive an increased risk of developing certain health problems due to excessive usage of mobile phones and technology. It has been evaluated that participants under the age group 15–30 years are highly affected (45.9%) during lockdown due to excessive dependence on technology. And, amongst different professions, participants involved in online teaching-learning are the most affected (42.6%).

Conclusion: The findings indicate that dependency on technology during lockdown has more health effects as compared to normal times. So, it is suggested that as more waves of pandemics are being predicted, strategies should be planned to decrease the psychological and physiological effects of the overuse of technology during lockdown due to pandemics. As the lockdown situation unfolds, people and organization functioning styles should be rolled back to the limited dependency on technology.

1. Introduction

Mobile phones have become an integral part of human life. With the evolution of mobile communication from 1G to 5G, there is also an increase in the frequency of the radiations used for communication. The frequency of communication of mobile phones falls in the range of 900 MHz to 2.5 GHz [1]. There are about 80 crores cell phone users and around 4.5 lakhs of cell phone towers installed to provide communication in India. The mobile phone towers transmit continuously and people living within a radius of 10 m from the tower are likely to receive 10000 to 10000000 times stronger signals than required for

communication over the mobile phone which may severely affect their health and overall well-being. Continuous and long-term exposure to low-intensity electromagnetic radiations may have negative effects on the biological system of human beings affecting their memory and cognition. Due to the enormous growth of mobile phone users throughout the world at a fast pace, the effect of mobile phone radiations on human health is a subject of great concern. A large number of studies have been performed over the last two decades to assess the risks posed by mobile phone radiations on human health [2,3]. Currently, the outbreak of the COVID-19 [4] has caused several organizations to be shut down and forced to initiate work from home employing technology.

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The purpose of the present research survey is to find out the problems faced by individuals and professionals, their perception towards the use of technology; and finally provide a case study to administrators and users to consider whether technology should be blended successfully with routine activities even in normal circumstances post-COVID 19 pandemic or not. This paper reviews long-term health effects of using mobile phone technology and surveys, studies, and analyses the short-term health side effects of using mobile phone technology while adopting the remote mode of working during the Pandemic.

1.1. Excessive use of mobile phone and health risks

Although radiation-emitting out of mobile phones are non-ionizing and hence appear to cause no harm to human, with the advent of 4G and 5G communication technology, the operating frequency has reached to the microwave range. Mobile phones kept in proximity may cause localized dielectric heating due to the interaction of living tissue with electromagnetic waves. Long-term exposure to these radiations may cause some dangerous and irreversible changes in the biological system of human beings which could cause irreparable loss to the brain functioning in the long run. World Health Organization (WHO) in 2011 classified RF radiation as a possible carcinogenic for humans [5–7]. Various studies have reported electromagnetic radiations to cause DNA damage. Single and double-stranded DNA might break in brain cells and increase the chances of apoptosis. Human blood leukocytes and lymphocytes when exposed to electromagnetic radiation may induce long-term chromosomal damage-causing gene mutation [8–13]. This may also trigger the release of harmful free radicals which may lead to loss of immunity, blood-brain barrier damage, changes in metabolism, impaired brain function, risk of cardiovascular disease, decreased bone density, cause type 2 diabetes, hormonal imbalance, mental stress, loss of blood sugar control, autoimmune, inflammatory disorders and genetic degenerative disease [14,15].

Loss of immunity may lead to increased chances of people getting infected by any kind of infectious virus including Covid-19. The people with low immunity are at greater risk due to this pandemic and therefore, old age people and children have been curtailed strictly from coming into public contact. Unfortunately, in the present time, the immunity of youngsters has also been compromised due to various activities and one of them is notably long hour exposure to mobile phone radiations. With the advent of a second strain of the COVID-19 which is considered to be more severe than the present one, it may cause long-term effects on the overall health, brain functioning, and neurology aspects of human health. The following section reviews related literature that examines various health effects of the introduction of technology in routine life. The methodology section describes the procedure carried out for conducting the investigation followed by the findings and result outcomes of the study. The limitation and future scope of the study are also presented. The conclusion section summarises the research outcome and answers the research question: whether dependency on technology during lockdown has more health effects as compared to normal time.

2. Mobile phone technology during COVID 19 lockdown

In March 2020, Government shut down all education institutes in India followed by a nationwide lockdown as a measure to constraint the spread of the Coronavirus. University Grants Commission (UGC) which looks after educational institutions in the country in association with the Ministry of Education (MoE), issued the circular regarding the use of Information Communication Technology (ICT) in teaching and learning [16]. Several organizations encouraged work from home for their employees keeping in mind the health safety scenario. So, during lockdown mobile phones have become an indispensable part of everyone's life. People are dependent on mobile phones for earning their living by scheduling work from home for online teaching and learning, online

Table 1

Specifications of Participants involved in the Survey.

Sr. No	Parameter	Response
1.	Total Participants	122
2.	Age Group	15–30 Years 31–40 Years 40–50 Years 50–75 Years
3.	Work Experience	0–5 Years 6–10 Years 11–15 Years 16–20 Years >20 Years

meetings, official work, and for processing online transactions. There has been enhancement in online classes, webinars, seminars, conferences through different software apps such as Zoom, Webex, Skype, Google Meet, GoTo Meet, etc. Some people use mobile phones for a prolonged period for their entertainment by watching videos, gaming, and surfing social sites to overcome boredom during the lockdown or containment period which may harm effective brain functioning. Therefore, as people are staying at home the usage of mobile phones has increased manifold in comparison with the regular use before the pandemic. A Hutchinson [17] assessed in his research that people have started spending 20% more time on apps during COVID 19 pandemic. This, in turn, exposes the human body to a higher level of radiation and that too for a longer duration. The need to keep pace with daily routine activities and tasks during the pandemic through the use of technology has enhanced the dependence on mobile phones which is widely available across all age groups. Lockdown during COVID19 Pandemic has restricted the physical activity of people as mobile phone technology has become a necessity to meet the daily work and personal requirements. Antonio Moreno Llamas et al. [18] studied the impact of digital technology development on the sedentary behaviour of the population. The author found that the introduction of digital technology has resulted in an extended sitting time of the participant. With the sudden rise in the usage of mobile phones for several hours, besides getting exposed to radiations being emitted from these devices, there arise several other health-related issues including mental stress, body pain, and effect on overall well-being. Deblina Roy et al. [19] in their research evaluated the mental health of people in India during COVID 19 pandemic. Authors assessed that healthcare need was observed in 80% of the participants.

3. Research problem and objective

The present research aims at uncovering the effects of excessive usage of technology during the time of lockdown due to pandemics. The study aims at finding the answer to the research problem: whether dependency on technology during lockdown has more health effects as compared to normal times. It also focussed on finding a relation between different dependent and independent variables of the study.

4. Methods

To analyse the effect of this situation, a survey has been conducted and data has been recorded from the people of 68 different cities from different states of India. The mode of conducting the survey was chosen to be online to maintain social distancing during the time of the Pandemic. A questionnaire was prepared in the form of Google Form which was composed of 17 questions self-designed by the investigators. A 5-point Likert scale was used (wherever applicable) to record responses from the participants (For a detailed questionnaire, see appendix A). The link of the questionnaire was forwarded to people e_mail, Whatsapp, and Facebook to the contacts of investigators. Participants were encouraged to roll out the questionnaire to as many contacts as

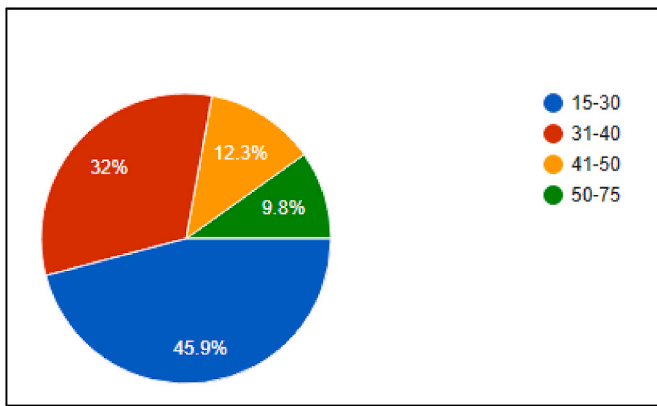


Fig. 1. Ratio of volunteers based on age.

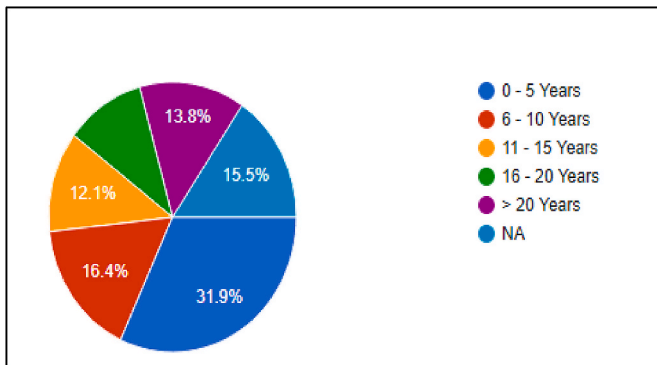


Fig. 2. Ratio of Participants based on work experience.

Table 2

Count of subjects assenting for technical Issues faced during online mode of work.

DEVELOPING CERTAIN HEALTH PROBLEMS DUE TO EXCESSIVE USAGE	Count of Total number of technical reasons affecting health
AGREE	69 (56.5%)
DISAGREE	6 (4.9%)
NEUTRAL	22 (18%)
STRONGLY AGREE	25 (20.5%)

possible. The participants belonged to various professions and different age groups. The specifications of participants who contributed to the study have been tabulated in Table 1. Participants belonged to different ages ranging from 15 to 75 years having work experience of 0–20 years. To obtain a more precise analysis, age groups and work experience was divided into subgroups and small ranges. The following section describes and discusses the methodology adopted to analyse the recorded data.

5. Results and discussions

The recorded data was analysed statistically in RStudio using the multiple regression analysis techniques to get meaningful interpretations from the information provided by the subjects.

Out of the total participants, 51.2% participants were male and 48% were female while the remaining belonged to the transgender category. Maximum participation was from the age group of 15–30 years, which accounts for 45.9% of total participation, which is followed by the age group of 31–40 years. The percentage participation of each group has been demonstrated in Fig. 1. Data is inclined towards people having work experience ranging from 0 to 10 years, whereas, people with work experience greater than 20 years also participated in the survey as depicted in Fig. 2. Most of the people are found to be using Vodafone-Idea, Airtel, Reliance Jio, and BSNL 4G Internet connectivity over the mobile network, Wi-Fi connection, and broadband connection. Due to the sudden rise in network demand during Lockdown, 80% of people have confirmed connectivity and bandwidth issues, whereas, other 20% have reported issues during Video Streaming, Audio Quality, Power Failure/Fluctuations, Hardware (Pc/Laptop/Smart Phone) issues and Software/Apps/LMS Inadequacy problems depicted in Table 2 and Fig. 3. Here, the x-axis denotes the choice of volunteers for developing certain health problems due to excessive usage of phones and the y-axis denotes the count of the total number of technical reasons affecting health. This sometimes leads to psychological health issues also, as users get irritated and it may take a longer time duration to complete the scheduled task leading to enhanced stress and anxiety issues.

Lockdown scenarios have led to an increase in the usage of mobile phone technology which has been confirmed by around 90% of participants. Only 10% of people use the phone for more than 2 h while the majority of the respondents were using it for elongated durations ranging up to 15 h a day as detailed in Fig. 4. The purpose of usage varies from online teaching/learning to connecting with family and friends. Details of usage have been plotted in Fig. 5. It has been analysed that online teaching/learning is the most affected profession during lockdown agreed by 42.6% of total participants as illustrated by Table 3 and Fig. 6. The x-axis denotes the count by lower work experience and the y-axis denotes the different purposes of electronic devices used. It can be

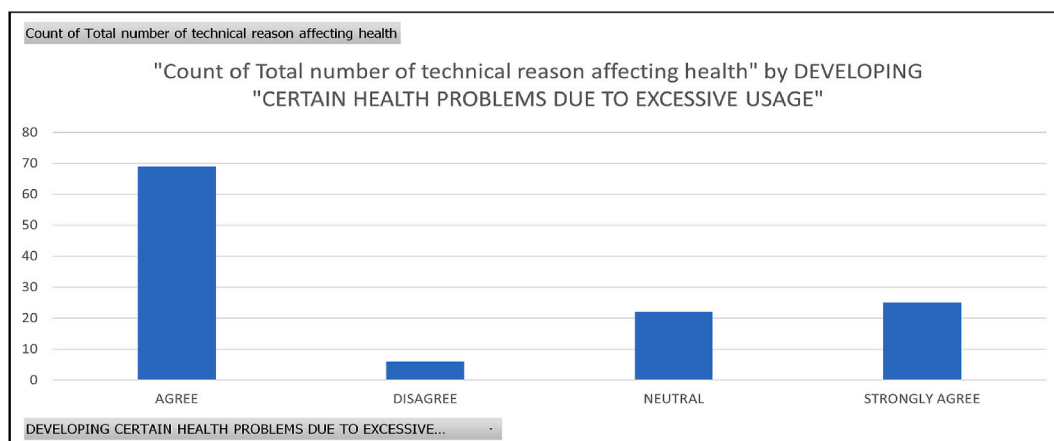


Fig. 3. Technical Issues faced during online mode of work.

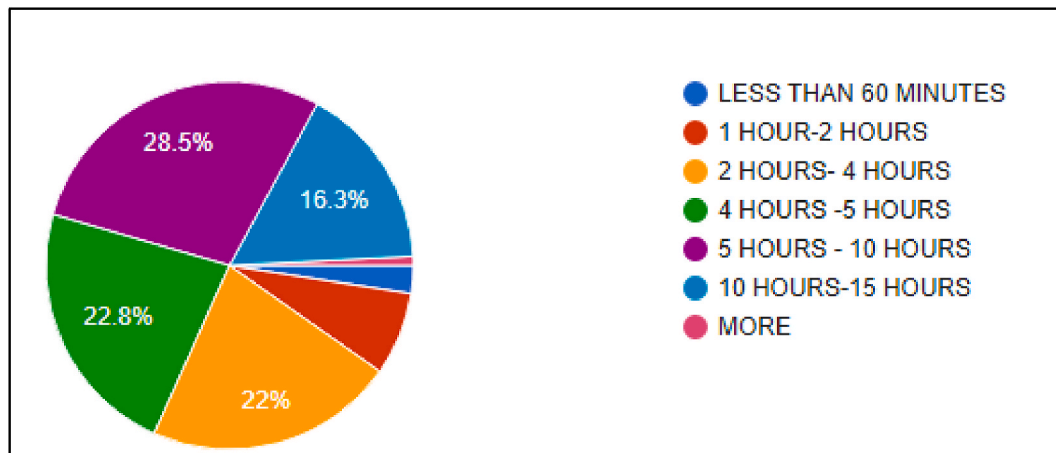


Fig. 4. Duration of usage of Mobile Phone Technology.

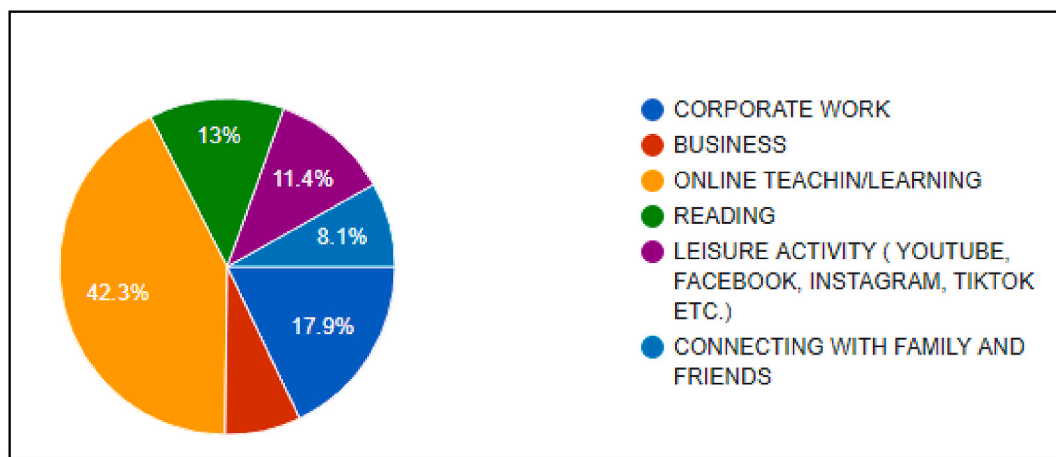


Fig. 5. Purpose of mobile phone usage.

Table 3

Count of subjects based on effect on health in accordance to purpose of electronic device usage.

PURPOSE OF USING ELECTRONIC DEVICE	Count of LOWER WORK EXPERIENCE
BUSINESS	9 (7.3%)
CONNECTING WITH FAMILY AND FRIENDS	10 (8.1%)
LEISURE ACTIVITY (YOUTUBE, FACEBOOK, INSTAGRAM, TIKTOK ETC.)	14 (11.4%)
READING	16 (13.1%)
CORPORATE WORK	21 (17.2%)
ONLINE TEACHING/LEARNING	52 (42.6%)

observed that people with lower work experience spend most of their time with the purpose of online teaching/learning. Thereafter, the order is from corporate work, reading, leisure activities, connecting with family and friends, and then business. Moreover, age groups that are highly affected by online work scenarios belong to lower age groups as depicted in Fig. 7. Here, the x-axis denotes the age group and the y-axis denotes the count of health affected of the volunteers. It is observed that the age group of 15–30 are affected excessively with the count number being 56 out of 122 (45.9%). The age group of 50–75 are affected less likely than any other groups as listed in Table 4.

95% of participants perceive an increased risk of developing certain health problems due to excessive usage of mobile phones and technology. Various discomforts that are being faced by participants while using

the mobile phone technology for an elongated duration of time include headache, Eyestrain/itchy eyes, Hearing Loss/Tinnitus, Sleep disorders, Obesity, mental Stress – Cognitive Behaviour and Emotional changes, Musculoskeletal (Neck/Back/Shoulder/Chest, etc.), Depression, Anxiety Discomfort in Face to Face Communication and Smartphone Addiction. 57.36% of people reported eye problems, 38.76% confirmed headaches, 34.88% reported sleep disorders, and 32.56% people suffer from musculoskeletal issues. Whereas, shortness of temper, obesity, anxiety, and decreased attention has also been reported by a significant percentage of participants. Depression and hearing problems have also been confirmed by few participants. Detailed distribution of the health discomforts w.r.t. percentage participation has been shown in Fig. 8. The investigation findings by Deblina Roy et al. [19] support the result outcomes of the present study with regards to anxiety and perceived mental healthcare needs in the Indian population during the COVID-19 pandemic. Many results of the present research find similarities with another research work conducted by Auvinen et al., 2019 [20] in which authors have reported long-term follow-up of headache and hearing impairment as a side effect of using a mobile phone. In other research conducted by Tugberk Kaya, 2020 [21], it has been evaluated that overuse of technology sometimes may lead to anxiety and panic, if people are not made aware of the real and fake social content. This can also be one of the reasons behind anxiety recorded in participants of the present investigation.

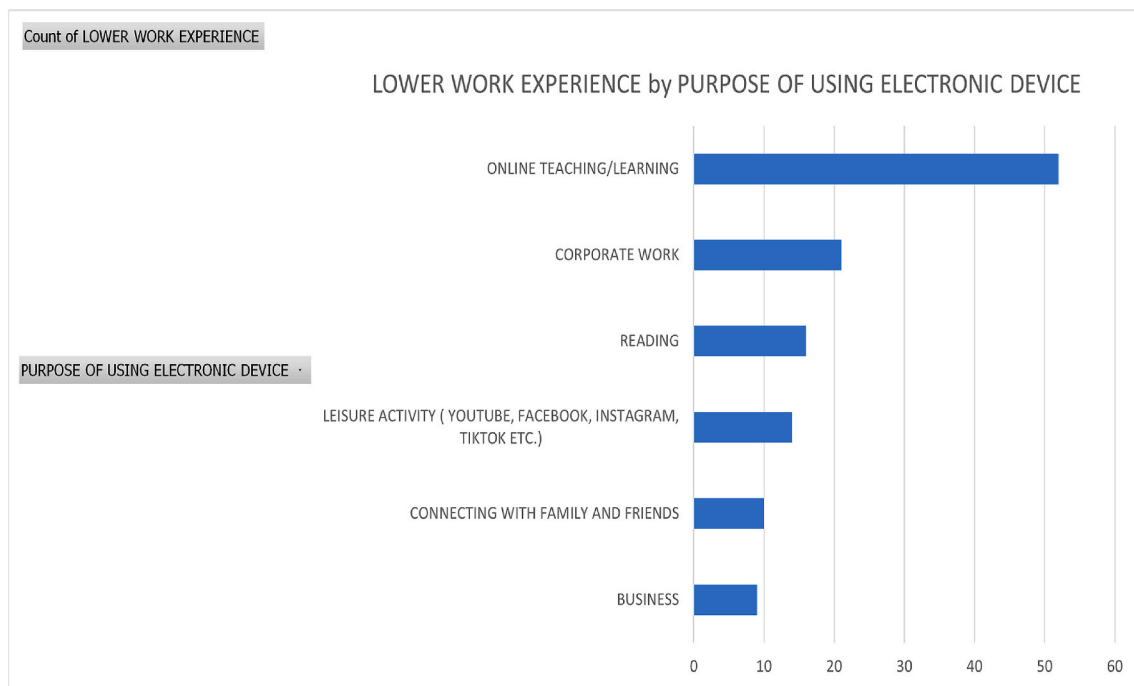


Fig. 6. Effect on health based upon different purpose of electronic device usage.

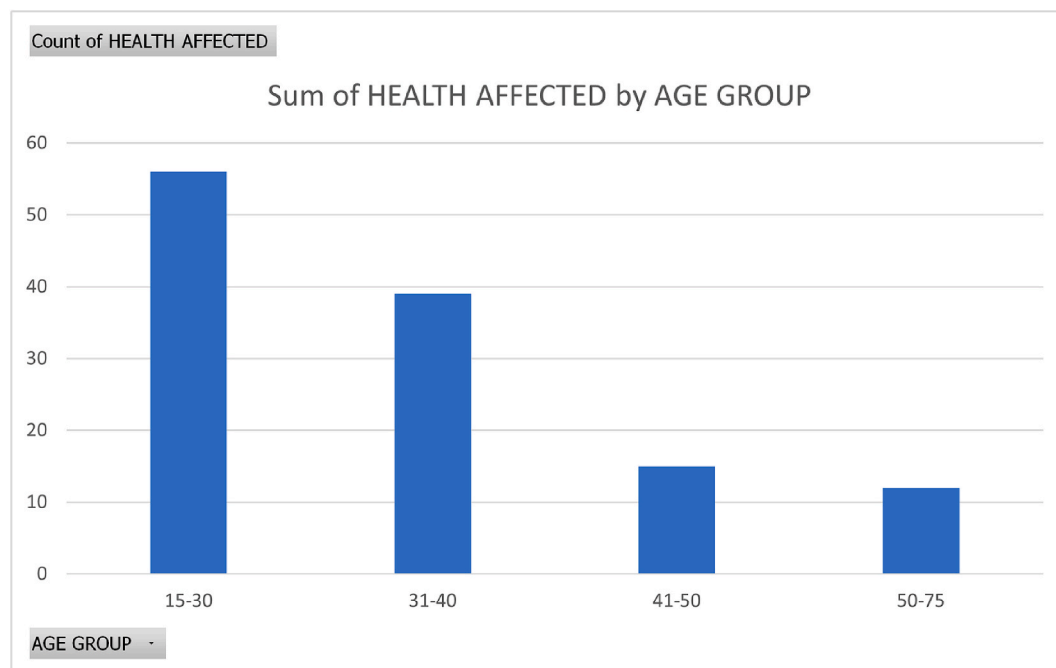


Fig. 7. Effect on health based on age groups.

Table 4

Count of subjects agreeing for effect on health during lockdown based on age groups.

AGE GROUP	Count of HEALTH AFFECTED
15-30	56 (45.9%)
31-40	39 (31.9%)
41-50	15 (12.2%)
50-75	12 (9.8%)
Total	122

6. Limitations and future scope

The research is limited to India as the survey was conducted with the Indian population which limits the generalization of results worldwide. Despite the limitation, this research work creates an opportunity to conduct similar research in other countries as well. Moreover, the survey was limited to an educated class of people who know English, as a questionnaire was framed in the English language. There is a class of people who use technology, but, are uneducated and prefer to answer the questionnaire in their mother tongue which could be done in future studies. In the physical survey, responses from such classes of people can

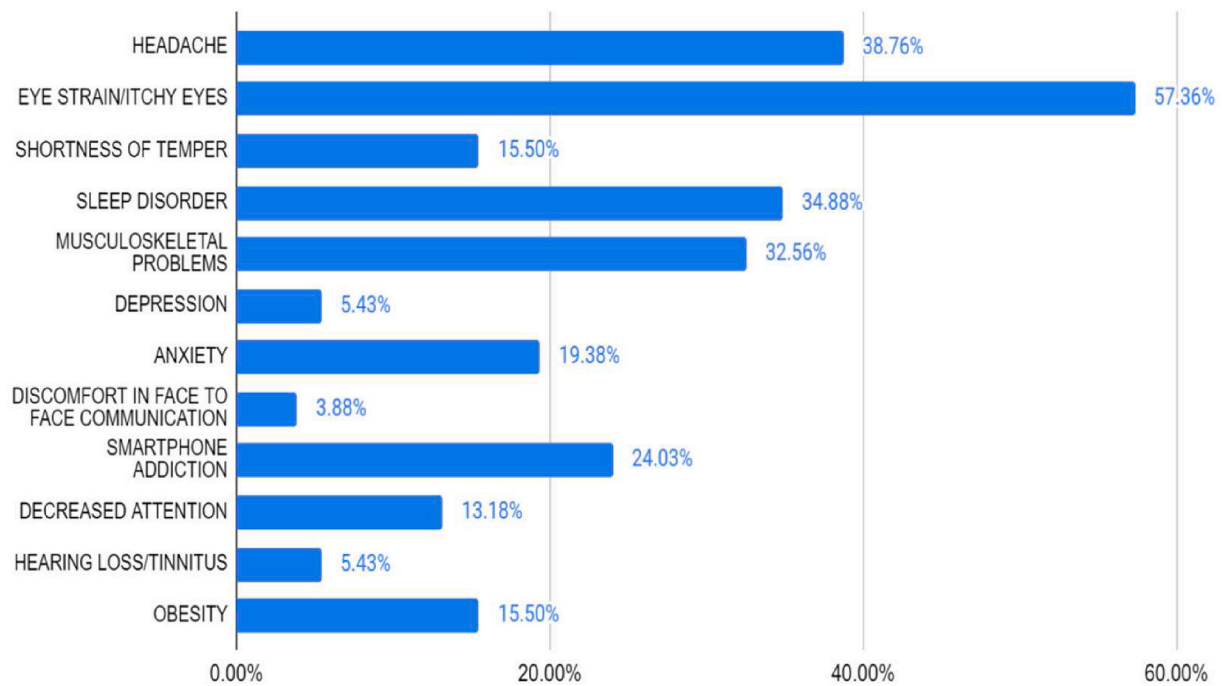


Fig. 8. distribution of health issues reported by participants due to elongated usage of mobile phone and technology.

also be recorded through verbal interaction. So, the study is not generalized to the whole population. Hence, it could be stated that in context of the small sample size and descriptive analysis makes this investigation more qualitative than quantitative.

7. Recommendations

There is a need to intensify awareness programs and address health issues of people due to excessive dependency on technology during the Pandemic. Government should plan effective strategies for the people and organizations. Work hours should have a minimum constraint as work from home scenario has led to elongated working hours. Academic calendars for students should be designed to keep the health effects of the overuse of smartphones and laptops while attending online sessions. Academic Institutes should be issued strict guidelines to avoid overcrowding of online courses and programs to keep the students engaged for longer durations of time thereby affecting their health due to continuous sedentary way of working with less physical activity. The gross happiness index should be focussed during the time of Pandemic by the Government over Gross Domestic Product. Moreover, it is also suggested that as the lockdown situation unfolds, people and organization functioning styles should be rolled back to the limited dependency on technology allowing more human-to-human interaction.

8. Conclusion

The Lockdown scenario due to COVID-19 has compelled people to adapt to the remote mode of working with the help of technology. Several literature studies have confirmed the adverse effects of excessive use of technology on human health [18–20]. This paper was an attempt to analyse the effects of the overuse of technology during the lockdown on users' health. This survey has interacted with diverse populations and analysis of data predicts that there are direct and obvious physiological and psychological health effects of overuse of technology. It has been evaluated that participants under the age group of 15–30 years are highly affected during lockdown due to excessive dependence on technology. And, amongst different professions, participants involved in online teaching-learning are the most affected. From the results

obtained, it can be concluded that the technology is a boon and life savior in many situations but, in long run, it has severe health effects if its use is uncontrolled for longer time durations. Nevertheless, the investigators observed that dependency on technology during lockdown has more health effects as compared to normal times. So, strict planning and implementation of strategies to decrease the psychological and physiological effects of a pandemic is required, if, more lockdown scenarios are imposed by the government during the second and third waves of the pandemic.

Author statements

This study has no funding and competing interest. Participation was completely volunteer based, and no formal ethical approval was obtained for the study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.techsoc.2021.101762>.

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